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ABSTRACT

This paper describes a middle school mathematics clinic in the District of Columbia Public Schools, which was designed to aid students in the transition from mathematics in the primary grades to high school mathematics courses. It is intended to provide the low achiever with effective diagnostic and corrective instruction by the best trained personnel. The description includes necessary facilities and materials, staff competencies and attributes, and client selection process. Suggestions regarding scheduling, instruction, record keeping and evaluation are also included. Appendices include a description of a student activity on plant growth and sample tests. (PK)

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MIDDLE SCHOOL MATHEMATICS CLINIC: A THEORETICAL MODEL

Conference paper for:
The National Council of States on In-Service Education National Convention---

November 22-26, 1985
Denver, Colorado

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INTRODUCTION

"Learning is a monitored, controlled and directed cognitive activity on the part of the individual, utilizing the information processing system of the brain for the purpose of modifying cognitive structures through assimilations and integration of new information (Letteri, 1985)"

Emperical data and the opinion of educators support the fact that, there exists a correlation between the increasing number of student failures and the complexity of mathematics activities. The 1985 California Test of Basic Skill results for the District of Columbia Public Schools substantiate this fact. The median score for less than 16% of the schools reported that third and sixth grades fell below the national norm, while this score was above this norm for only 55% of the schools where eighth and ninth graders were tested. This and other data reveal that serious mathematical disabilities appear during the middle school years. Although overall median scores of standardized tests appear to be on the rise, it is the responsibility of educators to improve the performance of all students, especially, those who consistently perform below their potentials.

Generally, students succeed in the primary grades by use of memorization to complete most of the tasks, but meet with less success upon entry to the middle grades where the

work gradually becomes more complex. Success in high school mathematics courses is directly related to an effective transition from the concrete to the obstract process of acquiring knowledge during the middle school experience. The middle school mathematics clinic provides numerous opportunities for this transition to take place.

The middle school mathematics clinic is a place where children with complex mathematics difficulties can be taught. It is equipped to systematically and efficiently evaluate the student problems and to develop corrective plans that will remediate and provide specific activities to enhance long term learning. After at least nine weeks of clinic instruction the clients (students) will be able to return to and to function successfully in the regular mathematics class.

The Clinic

The middle school mathematics clinic should be a resource laboratory (large classroom) containing mathematics and achievement tests as well as psychological assessments. Cuisenair rods, numberlines and kits (metric, or geometric) should be among the numerous manipulatives to be used in the transformation of concrete activities to abstract ideas. Flexible furniture, tape recorders, carrels and projectors will be examples of hardware to supplement the learning process. Also, space will be available to complete and to display special projects such as the "Giddings Plant Hospital" (see appendix I) and student exhibits.

Instructional software that will systematically, and efficiently, diagram clients' mathematics difficulties and to prescribe procedures to follow in effectively remediating the problems also be included in addition to tests. Resources (money and/or in kind gifts) to enhance the project may be acquired as grant funds and donations from the business community. The completion of these projects are necessary in that newly learned skills are applied in practical situations as peer groups develop and/or improve positive social skills.

The clinican - A highly trained clinican (teacher) will teach and manage the clinic activities. The assistance of an aide or an university student fulfilling a practicum requirement will greatly enhance the effectiveness of the clinican. Compentencies of this mathematics clinican should include a positive attitude toward low achievers as well as problems unique to the transescent (10-14 year old students). The following are course descriptions that should be taken in preparation for this position:

--- Psychology of the transescent (3 semester hours)) Study of physical, mental and cognitive development of the transescent and how these factors are directly related to the acquisition of mathematical concepts.

--- Mathematics clinic theory (3 semester hours) Review of research; analysis of current remedial programs; theoretical structures of programs and clinic designs.

--- Mathematics clinic practicum (6 semester hours) (a) observation of clients being diagnosed and treated for mathematical disorders, (b) students to diagnose and apply effective treatment under the supervision of university staff, (c) students to provide the above services to clients utilizing university assistance only as needed, and (d) students to complete a research project using graduate level procedures that are related to at least one of this clinical approach to remediation to insure knowledge of content and possible middle school certification in mathematics the clinican should complete courses such as Geometric Linear Algebra, Elementary Geometry, Number Theory and Algebra, Calculas from a numerical viewpoint, Probability and Statistics, Logic and Psychology in School Mathematics.

Client Selection - Several criteria should be used in the client selection process for more accurate identification. The following is a suggested method of completing this task:

FIGURE 1

	A	B	C	D
Category	Recommendation by Support Staff Teachers Principal	Final Grade Math	Standard Test Raw Score	Grade Wide Survey Test Raw Score
Numeric Weight	1 Recommended 2 Not Recommended	0-4*	Actual Raw Score	Actual Raw Score

* 0=F 4=A

FIGURE 2 - Sample Student List (Gr. 5)

Student	Category A	B	C	D	Total Score	Ranking
1	1	0	5	3	9	6
2	2	0	4	7	13	8
3	1	2	7	8	18	9
4	2	1	3	4	10	7
5	1	2	2	3	8	4
6	2	3	1	0	6	2
7	1	1	10	9	21	10
8	2	1	4	1	8	5
9	1	1	2	4	8	3
10	1	1	1	2	5	1

Note: If the total score is the same for two students, then, the student having a score of one in category A will be given priority.

Students should be ranked in numerical order with the smallest total number having highest priority thus having the greatest need. Those fifteen students having the smallest totals, will be assigned to the clinic first. Those students who will be ranked numer sixteen through twenty-five will be assigned to the waiting list. As vacancies occur spaces will be assigned beginning with the client having the greatest need.

Diagnostic and/or diagnostic test data will be used to determine instructional groups within the classes. The process for completion (student work) will be evaluated based on error types such as: basic facts, place value, knowledge of properties related to operations (identity element for addition) or applying steps to complete equations (multiplying improper fractions).

Scheduling - Identified clients will be scheduled in the clinic daily instead of regular classroom instruction. For instance, all fifth graders in the school will receive mathematics instruction during first period. The second period will be mathematics for all grade six students, including those attending the math clinic. At least one seventh grade regular class and the seventh grade math clinic will be scheduled daily for period three in order to accommodate the identified clients, those on the waiting list and those who will return to regular instruction during the semester. Similar scheduling will be done for grade eight (see figure 3).

FIGURE 3

Suggested Schedule for Mathematics Clinic

Period	Grade		Day Mon.	Tues.	Wed.	Thurs.	Friday
1	5 Group	A	TD	D&P	TD	App.	D&P
		B	App.	TD	D&P	D&P	TD
		C	D&P	TD	App.	TD	App.
2	6 Group	A					
		B					
		C					
3	7 Group	A					
		B					
		C					
4	Lunch						
5	8 Group	A					
		B					
		C					
6	Flexible		Prob. Solving	Special Projects		Contests	Contests
7	Planning		Planning				

Note: --Groups A,B,C will be identified based on error analysis of diagnostic test data.

--Clients will be grouped according to interest or project

--TD - Teacher directed

--D&P - Drill and Practice

--App - Application of skills (prob. solving or projects)

The clinican will supervise the completion of mathematics projects and/or clubs during the flexible period. Interested groups or individuals will be free to sign up for the flexible period based on interest. This period will be open to all students.

Instruction - The philosophy for instructing the math clients will be based on "Life Skills: A Working Definition" (Gore, 1980). It stated in part:

"The term "life skills" in the curriculum refers to the transformation of academic theory into tools for identifying, generating, and solving problems in real life situations. The study of life skills is done in three distinct stages of development, known as readiness, concrete and advanced. The instructional activities for each of these stages are designed according to the cognitive levels of students and not necessarily chronological or grade levels.

Lessons for the first or readiness stage are utilized for students whose instructional levels are at grade two or below. The majority of the learning tasks are oral. They result from vivid motivational devices such as field trips,

pictures or a community event. As characteristic to this stage, these tasks are child and community centered. Applications of concepts developed are solved in one step. For example, adding the total enrollment for four first grade classes is needed to find the number of students who visited the zoo.

A gradual movement toward complexity dominates the activities of the second or concrete stage. Both oral and written problems are generated from a local and a national scope. The majority of these related problems are solved by using two steps. The ability to read and to understand mathematics up to grade six is necessary to complete activities of this stage. To determine the average enrollment of six classes is a classic example of a two step problem. It is necessary to add then divide in order to solve it.

The third or advanced stage deals with the application of abstract ideas from which to identify, solve and generate problems. In order to solve the multiple step problems at this level, the student should have reached the "formal operation" stage as identified by Piaget and described by Helmore (1969). These problems include topics related to issues that may or may not have clear answers. Deciding which of three professionals will become a workaholic by age 35 based on related research is an example of such problems.

The life skills approach will be implemented in the mathematics clinic. Individual client programs will be designed based on academic needs and intellectual development. Concepts related to instructional objectives will be developed via teacher directed activities. New and existing materials will be utilized for needed drill and practice. The application of concepts will be implemented through problem solving and the completion of projects and contests.

This approach is illustrated in the example as follows:

Given an identified client evaluated and found to be deficient in converting metric measures from unit to unit, the clinican will utilize the criteria in figure 4 for determining the quantity and which of the activities (see figure 4,5) she will need in order to correct this problem.

Figure 6 is an example of assessment tasks to be used for the certification of mastery of this deficency (see figure 6).

Projects such as "Giddings Plant Hospital" should be completed by individuals and/or groups as a means of applying skills learned. A description of this project is as follows:

"The plant hospital will consist of as many sick plants as the hospital staff (involved students) can find. Each staff member will have a chance to choose a plant to nurse back to good health or to describe specific action. In doing so, he will find out as much as he can about it by:

FIGURE 4

CRITERIA FOR SELECTING INSTRUCTIONAL ACTIVITIES

CORRECT RESPONSES FOR DIAGNOSTIC TEST DATA	INDEPENDENT DRILL	TEACHER DIRECTED ACTIVITIES	DRILL & PRACTICE (INDEPENDENT)	(PROBLEM SOLVING) APP (LIFE SKILL)	ASSESSMENT
100-85%	At least one			2	1
84-51%		3	2	1	1
50%-BELOW		3	3	1	1

* NOTE: If student scores less than 85% on the assessment test, he/she is to go back through the procedure utilizing different instructional activities related to the identified objective.

FIGURE 5

Grade 6

TEACHER DIRECTED ACTIVITIES

REVIEW: 1m = 1,000mm.
1 liter = 1,000ml.
1g = 1,000mg.

(NOTE): When converting a measurement given in metric from a specified smaller metric unit to a larger unit, divide.

(1)
- Convert the following measurements:

mm to m ml to l mg to g

(2)
- multiply and convert from a larger unit (liter, meter, gram) to a smaller unit:

(3)
0.0051 = _____ml (1,000x.005 = 5ml)

- Change a given number to meters to millimeters, liters to milliliters, and kilometers to grams by multiplying the number of meters, liters, or grams by 1,000.

- Continue this procedure using other examples.

INDEPENDENT ACTIVITIES

(Drill & Practice)

1. Have students to convert from milligrams to grams, milliliters to liters, millimeters to meters. (page 728)

Smaller Unit	÷	Larger Unit
example:		
200.00ml	1000	.2g

2. Repeat this procedure converting a smaller unit to a larger unit.

3. Convert metric units using the prefixes milli, centi, deci, deka, hecto, and kilo. (page 13)

4. Review of multiplication by 1,000, 100, 10, 0.1 and 0.01. (page 11)

5. Solve word problems utilizing multiplication skills (thousands) (page 23)

APPLICATIONS

1. Use a scale to find distances on a simple map.

2. Change one or more words so that the statements will become meaningful sentences. (page 24)

3. PROJECT:

Allow students to photograph a neighborhood scene. Then develop a scale for the item.

EXAMPLE

Take a snapshot of the front of your school. Measure the front door in reality and on the picture. Compare the two to develop a scale for the other objects in the picture.

Use this method to develop scales for other scenes.

INFORMAL ASSESSMENT TASKS

FIGURE 6

GRADE 6

CHECK-IN DATE _____ CHECK-OUT DATE _____

COPY AND COMPLETE:

1. 5m = _____cm.

2. 42.6cm = _____mm.

3. 0.29kl = _____l.

SHOW THE CONVERSION OF EACH MEASUREMENT BY RECORDING THE CORRECT ANSWER:

4. 3000mg.

3g. 30g. 300g.

5. 78mls.

0.0781. 0.781. 0.00781.

SOLVE THE PROBLEM:

6. Mt. Evans is .7cm. from Carson City on a map. Each .2 centimeters stands for 50 kilometers. If one drives from Mt. Evans to Carson City, he will travel _____ miles.

(a) researching its name or best growing conditions, (b) experimenting to determine under what circumstances it will thrive, and/or (c) generating records of appearance, growth patterns and materials used.

Weekly staff meetings will be held to share experiences, exchange plants, and/or plant sales.

At given intevals the oversupply of plants will be sold slightly above costs (determined by staff). The profits will be used to buy supplies.

Record keeping - Records of client progress should be kept by both the clinican and the client. Figure 7 is an example of what the teacher may note. The same form filled out by a client should supply clinic experience as perceived him. A comparison of data from both sources should provide greater insight of the goal attainment of the clinic.

Other type of records should be maintained by the clinic. Grades should be determined in that this experience is the client's mathematics class. Attendance cards should also be kept up to date. Finally, inventories of instructional hard and software is necessary to plan for instruction.

Evaluation - Mathematics clinics like other special programs should be reviewed at given intevals to determine the level of effectiveness. Standard and nonstandard tests, surveys and student records are among the devices most commonly used for this type of project evaluation. Pre and

FIGURE 7

INDIVIDUAL STUDENT PROFILE

Name Jane Smith Gr. 7

Objective	Activity/Comment(s)	Date of Mastery
I. Converting metric measures from larger to smaller units:	(Teacher/Comment(s) Teacher directed -- Use of metric C^2 cubes and meter sticks to illustrate linear measures. -- Complete activities 1 and 2 Drill and Practice Complete activity 1 and 4 Assessment tasks Applications 1, 2 and 3 (schedule student in during flexible period) Allow student to work in plant hospital to chart growth of tomatoe plants. *(Give additional practice using meter stick for vertical measures.) (Client comment) mm and cm scem to be the same.	11/14

15

post test data is generally used to determine academic gains of clients. Attendance and student profiles will provide insight to which materials and methods should be continued for the correction of specific disabilities. Feed back related to perception of the project by clients, parents and school personnel should be collected by using surveys and questionnaires.

Summary

The middle school clinic will provide the low achiever effective diagnostic and corrective instruction by the best trained personnel available. His chances for success will be greatly increased in that he will no longer be forced to simultaneously adjust to the methods, materials and expectations of the classroom and the remedial teachers. Because this scheduling he will not miss special events and electives to be made available for his classmates. The inclusion of the development of higher thinking and other experiences will have a profound effect of the high school experience of this low achiever.

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Appendix I

CBC CENTER
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PRESIDENTIAL BUILDING NINTH FLOOR

PROPOSAL FOR CBC EXEMPLARY PRACTICES AWARDS

Title of Project Giddings Plant Hospital

Submitted by Ethel V. Gore

Grade Level or Subject Area Mathematics/Science (4-6)

Rationale

1. To provide first hand experience in observing a wide variety of plants and their growth patterns.

2. To provide the pupils a chance to organize and to operate a small business.

Project Description

The plant hospital will consist of as many sick plants as the hospital staff(involved students) can find. Each staff member will have a chance to choose a plant to nurse back to health. He will then find out as much as he can about it by: (a) researching its name(common and scientific), (b) finding its best growing environment, and (c) maintaining written records of appearance, growth and materials used.

Weekly staff meetings will be held to share experiences, exchange plants, plan trips, organize open house and plant sales. Discussions of the hospital budget including ways to stay within it and to achieve the above goals.

At given intervals, the over supply of plants will be sold slightly above cost(determined by staff). The money generated will be used to buy supplies.

Objectives

(Sience)
The pupils will be able to:
-identify a large variety of plants.
-learn more about a plant(from germination to full growth).
-see the importance of proper environment for plants.
(Mathematics)
The pupils will be able to:
-keep records containing several variables over time.
-project a simple budjet, then have the experience of implementing it.
-determine retail pricing as well as wholesale pricing.

Target Population

Thirty pupils from grades four through six will be included in the project. The criteria will be (a) the ten pupils maintaining the highest grade point average and (b) are not behavior problems.

Materials

The teacher and the pupils need the following materials to get ge the project started:

- Potting soil
- Resource books and prints
- Money for transportation for the field trips
- Plant food
- Planters
- Sick plants and/or seeds

Project Cost

Transportation (3 trips)	$150.00
Resource books, prints, ets.	30.00
Potting soil	25.00
Planters	15,00
Plant food	15.00
Miscellaneous	20.00

Evaluation

(Formative) During the sharing periods, the hospital staff will discuss what problems they have encountered. They will also, review the project goals and decide if they are on target.

(Summative) At the end of the school year, the hospital staff will submit and annual report to show:

1. A complete summary of records
2. A complete budjet report.

A narrative report consisting the comments of all staff as to whether the project met its goals and if it should be continued.

Time Line (Major activities)

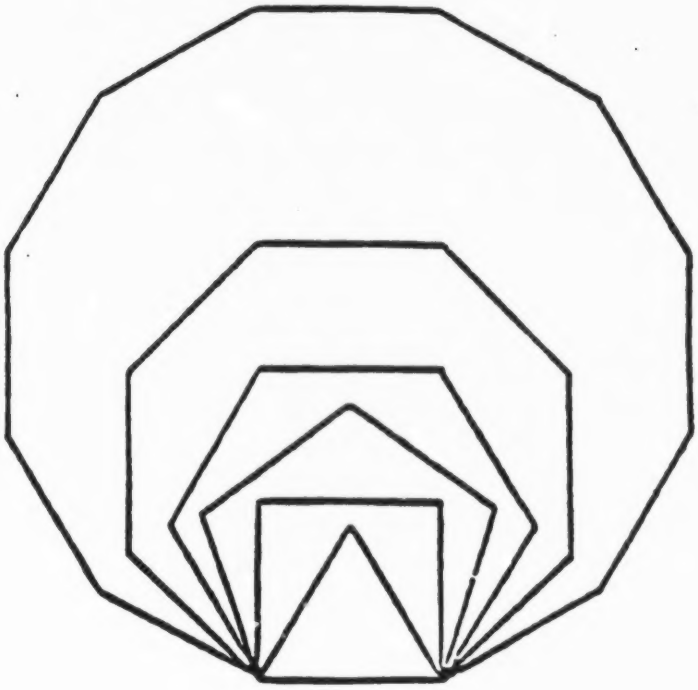
The group will meet each Thursday (1:50-2:20 pm)
December--1st meeting--Introduction of goals and organization of staff
January--Trip--National Arboretum
February--Trip--National Arboretum
March--Open house for all students in the school--Plant sale
April--Trip--National Arboretum
May--Staff to host information tours of the hospital (parents and students in the school--Final plant sale
June--Evaluation--Summative

Appendix II

Teacher's Manual

SECONDARY MATHEMATICS

SURVEY TEST



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Mattie Y. Parham	Hart Junior High School

Mathematics Curriculum Writers

Purpose of the Secondary Mathematics Survey Test

The Secondary Mathematics Survey Test is designed to aid teachers in determining the entry level of the secondary student of mathematics.

Knowing the entry level of a student enables the teacher to determine:

- the student's understanding of concepts and ability to perform skills necessary for the successful completion of a course;
- appropriate instructional-level prescriptions for each student;
- the amount of time which will be necessary to allot to each unit of instruction;
- the approximate instructional level of each student within the mathematics continuum.

Teachers should be cautioned, however, about basing a student's entire instructional program on the basis of one test.

Regardless of test performance, students will remain in their grade of placement with few exceptions. The Secondary Mathematics Survey Test can be used in designing a plan of assistance for each student or group of students within the class.

During the 1985-86 school year, it is anticipated that this test will be normed to the performance of students in the District of Columbia Public Schools. Based on the design of the test, the following results are anticipated:

Number of Correct Responses	Approximate Grade Level
10	4th
20	5th
30	6th
40	7th
50	8th
60	9th

As noted in the "Answer Key and Correlation of Items to Objectives" in this manual, forty-one items on the test assess objectives from the Elementary Mathematics Curriculum Guides. The instructional activities in those Guides provide appropriate prescriptions for indicated deficiencies.

Administration of the Secondary Mathematics Survey Test

After a review, teachers are encouraged to administer the test by the end of the third week of school. Students are to be allowed a maximum time of 60 minutes to complete the test; thus teachers may have to schedule testing over two class periods.

Scoring of the Secondary Mathematics Survey Test

Since the test uses the multiple-choice format, it is possible to use a scanner for scoring. A sample answer sheet for an NCS scanner is included in this manual. If an NCS scanner is used, it is necessary to use NCS answer sheets with an A-E format; an answer key is required as the first sheet scanned.

Hand scoring is also possible. An answer key is included in this manual.

Answer Key and Correlation of Items to Objectives

Item	Answer	Objective Code	Item	Answer	Objective Code
1.	E	WA-15	31.	D	DA-5
2.	A	WS-10	32.	C	DS-4
3.	E	WM-3	33.	D	DM-4
4.	D	WM-9	34.	E	DD-4
5.	B	WD-5	35.	D	ND-13
6.	C	NW-24	36.	A	CFD-2
7.	B	NW-26	37.	E	RN-27
8.	C	RN-10	38.	C	RN-29
9.	C	G-10	39.	E	RN-23
10.	C	Gr-5	40.	E	MCo-23
11.	E	WA-16	41.	D	FP7-3
12.	C	WS-11	42.	E	FP7-11
13.	E	WM-17	43.	B	WD7-4
14.	C	CFS-4	44.	B	FP7-6
15.	C	ND-3	45.	D	GM7-20
16.	B	WD-13	46.	A	FP7-16
17.	D	RN-15	47.	B	GM7-24
18.	C	MCLn-7	48.	B	GS7-5
19.	C	Gr-6	49.	B	S-8
20.	A	G-11	50.	A	GM7-9
21.	C	DS-3	51.	C	WD8-1
22.	D	DM-1	52.	C	WD8-3
23.	A	GFM-4	53.	D	FP8-9
24.	C	WD-15	54.	E	WD8-7
25.	B	S-13	55.	B	FP8-12
26.	C	CFA-7	56.	E	GM8-15
27.	C	CFS-8	57.	A	A8-5
28.	B	G-18	58.	D	A8-1
29.	D	MCo-18	59.	B	A8-4
30.	C	DA-4	60.	C	A8-6

Items 1-40 and 49 are correlated to objectives in the Elementary Mathematics Curriculum Guides.

Items 41-48 and 50-60 are co related to objectives in the Junior High School Mathematics Curriculum Guide.

Directions to the Students

- You will need scratch paper. Do not write in the Test Booklet.
- You will need a "No. 2" pencil.
- Each question has only one correct answer.
- Diagrams are not drawn to scale.
- Calculators are not permitted.
- If you make a mistake on your answer sheet, erase completely.
- Do not spend too much time on any one problem.
- Check your answers.
- You have one hour to complete the test.

1. $\begin{array}{r} 809 \\ +672 \\ \hline \end{array}$

A. 137

B. 173

C. 277

D. 1471

E. 1481

2. $\begin{array}{r} 908 \\ -869 \\ \hline \end{array}$

A. 39

B. 61

C. 139

D. 149

E. 161

3. $8 \times 7 = \square$

A. 1

B. $1\frac{1}{7}$

C. 15

D. 48

E. 56

4. $\begin{array}{r} 261 \\ \times \quad 3 \\ \hline \end{array}$

A. 258

B. 263

C. 264

D. 783

E. 983

5. $5\overline{)93}$

A. 18

B. 18 R3

C. 18 R5

D. 81

E. 81 R3

6. 236 rounded to the nearest <u>ten</u> is $\square$.

A. 200

B. 230

C. 240

D. 245

E. 300

55. $\square$ % of 60 = 15

A. $\frac{1}{4}$%

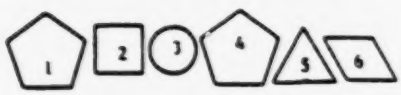
B. 25%

C. 45%

D. 75%

E. 900%

56. Which figures appear to be congruent?



A. 2 and 3

B. 1 and 5

C. 2 and 6

D. 3 and 6

E. 1 and 4

57. Translate: "three more than four times X".

A. 4X + 3

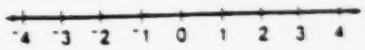
B. 3X + 4

C. 12X

D. 7X

E. -4X + 3

58. Which of the following statements is true?



A. $-4 > -3$

B. $-4 > 3$

C. $-3 > 4$

D. $3 > -4$

E. $3 > 4$

59. If X = 3 and Y = 5, then $(X + Y)(X - Y) = \square$.

A. -64

B. -16

C. 6

D. 16

E. 64

60. Solve: $4X + 18 = 90$

A. X = -27

B. X = -18

C. X = 18

D. X = 27

E. X = 228